

REMARKS

Reconsideration of the subject application is requested in view of the preceding amendments and the following remarks. Claims 20-35 are pending. By this Amendment, claims 20-35 are amended, and new claims 36-55 are submitted for consideration. Upon entry of this Amendment, claims 20-55 are in the application.

Support for the amendment to the specification can be found at, for example, page 13, line 1. Support for new claims 36-55 can be found in the specification at, for example, page 8, line 5 to page 9, line 17, page 11, line 24 to page 15, line 4, and throughout the specification. No new matter is introduced.

The drawings are objected to under 37 C.F.R. § 1.83(a) as allegedly failing to show every claim feature. FIG. 3 is revised to include a laser situated to illuminate a reticle, and withdrawal of the objection is requested.

Claims 20-30 stand rejected under 35 U.S.C. § 112, 1st paragraph, as allegedly not being enabled by the specification. This rejection is traversed. Claim 20 as amended recites an off-axis optical imaging system configured to form an image of an object on a surface. The optical imaging system comprises a catadioptric optical system having an optical axis and configured to form an intermediate image of the object, wherein the intermediate image is displaced from the optical axis. A refractive optical system is configured to form an image of the intermediate image on the surface, wherein at least one of the catadioptric optical system and the refractive optical system includes an aspheric optical surface. The Office action contends that the phrase "at least one" recited in claim 20 could include one, two, three, four, etc. This contention is false. The recitation "at least one of the catadioptric optical system and the refractive optical system includes an aspheric optical surface" means that either one or both of the catadioptric optical system and the refractive optical system includes an aspheric surface. The phrase "at least one" as used in claim 20 cannot include three, four, etc. Claim 28 also uses the phrase "at least one" in a similar manner. Withdrawal of this rejection is requested.

Claims 21 and 29 stand rejected under 35 U.S.C. § 112, 1st paragraph, as allegedly not being enabled by the specification. This rejection is traversed. Claims 21 and 29 as amended recite off-axis optical systems having a maximum image-side numerical aperture (NA) that

includes a numerical aperture of 0.6. The Office action contends that claim language stating that a numerical aperture is at least 0.6 could include numerical aperture values of 1.0, 15.0, or other values. Applicants request that the Examiner provide a reference that supports the availability of numerical aperture values such as 15.0. Support for a numerical aperture value of 0.6 can be found at, for example, page 12, line 22. Withdrawal of this rejection is requested in view of the amendments to claims 21 and 29.

Claims 22 and 30 stand rejected under 35 U.S.C. § 112, 1st paragraph, as allegedly not being supported by the specification. This rejection is traversed. Claims 22 and 30 as amended recite, in part, an optical imaging system having an image height on a surface of at least 10 mm. The specification states that, in a particular example, a maximum object height is 72 mm with an optical system magnification of $\frac{1}{4}$. Therefore, according to this example, an image height is 18 mm. See, for example, page 12, lines 20-25. Withdrawal of this rejection is requested.

Claim 30 stands rejected as allegedly being indefinite under 35 U.S.C. § 112, 2nd paragraph. Withdrawal of this rejection is requested in view of the amendments to claim 30.

Claims 20-22 and 25-26 stand rejected as allegedly anticipated by Palmer, U.S. Patent 4,714,307 ("Palmer"). This rejection is traversed. Claim 20 as amended recites an off-axis optical imaging system configured to form an image of an object on a surface. The optical imaging system comprises a catadioptric optical system having an optical axis and configured to form an intermediate image of the object, wherein the object and the intermediate image are displaced from the optical axis. A refractive optical system is configured to form an image of the intermediate image on the surface, wherein at least one of the catadioptric optical system and the refractive optical system includes an aspheric optical surface. Palmer does not teach or suggest such an off-axis optical imaging system. Instead, Palmer discloses a catadioptric lens configured to form an intermediate image on an axis of the catadioptric lens. See Palmer, sheet 1. A catadioptric lens according to Palmer has a central obscuration, but is configured to form an image on the optical axis. Therefore, claim 20 and dependent claims 21-27 and 36-54 are properly allowable over Palmer.

Claims 20 and 25-26 stand rejected as allegedly obvious from a combination of Palmer and Moskovich, U.S. Patent 4,971,428 ("Moskovich"). This rejection is traversed. As discussed above, claim 20 as amended recites, in part, an off-axis optical imaging system configured to form an image of an object on a surface. The optical imaging system comprises a catadioptric

optical system having an optical axis and configured to form an intermediate image of the object, wherein the intermediate image is displaced from the optical axis. Palmer does not teach or suggest an off-axis optical system, and Moskovich fails to cure the deficiencies of Palmer. Moskovich discloses a catadioptric zoom lens configured to form an intermediate image on an axis of the zoom lens, but does not teach or suggest an off-axis optical system in which an intermediate image is displaced from an optical axis. Therefore, claim 20 and dependent claims 21-27 and 36-54 are properly allowable over any combination of Palmer and Moskovich.

Claims 20, 23, 25-28, 31, and 33-35 stand rejected for alleged obviousness-type double patenting over claims 1-16 of Takahashi, U.S. Patent 5,805,344, Palmer, and Friedman, U.S. Patent 4,779,966 ("Friedman"). This rejection is traversed. Claims 20, 23, 25-28, 31, and 33-35 are amended to recite off-axis optical systems that are neither taught nor suggested by any combination of Palmer, Friedman, and claims 1-16 of Takahashi. Withdrawal of this rejection is requested.

New claim 55 recites an off-axis optical system configured to form an image of an object on a surface. As noted above, no combination of Palmer and Moskovich teaches or suggests an off-axis optical system, and claim 55 is properly allowable.

In view of the preceding amendments and remarks, claims 20-55 are in condition for allowance and action to such end is requested.

Respectfully submitted,

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**Marked-up Version of Amended Claims and Specification
Pursuant to 37 C.F.R. §§ 1.121(b)-(c)**

In the Specification:

Please replace the paragraph beginning on page 13, line 15, with the following new paragraph:

--FIG. 3 shows an optical path diagram of Example Embodiment 1 of a catadioptric optical system according to the present invention. As shown in FIG. 3, an excimer laser E is configured to illuminate the reticle R. The optical system of FIG. 3 can be used with the embodiment of FIGS. 1(a) 1(c) or 2(a) 2(c). In FIG. 3, the reflecting surface M2 is planar and the surface of lens element L in the optical system B nearest to the reflecting surface M2 is aspheric.--

In the claims:

Please amend the claims as follows:

20. (Amended) An off-axis optical imaging system configured to form an image of an object on a surface, the optical imaging system comprising:

a catadioptric optical system having an optical axis and configured to form an intermediate image of the object, wherein the intermediate image is displaced from the optical axis; and

a refractive optical system configured to form an image of the intermediate image on the surface, wherein at least one of the catadioptric optical system and the refractive optical system includes an aspheric optical surface.

21. (Amended) The off-axis optical imaging system of claim 20, wherein [an] a maximum image-side numerical aperture (NA) of the off-axis optical imaging system [is at least] includes a numerical aperture of 0.6.

22. (Amended) The off-axis optical imaging system of claim 20, wherein an image height on the surface is at least 10 mm.

23. (Amended) The off-axis optical imaging system of claim 20, further comprising a reflective surface arranged to direct a light flux from the catadioptric optical system to the refractive optical system.

24. (Amended) The off-axis optical imaging system of claim 20, wherein the refractive optical system includes an aperture stop.

25. (Amended) The off-axis optical imaging system of claim 20, wherein the aspheric optical surface is a refractive optical surface.

26. (Amended) The off-axis optical imaging system of claim 20, wherein the aspheric optical surface is a reflective optical surface.

27. (Amended) An exposure apparatus comprising:
[a reticle;]
[an ultraviolet excimer] a laser situated to illuminate [the] a reticle;
a substrate; and
the off-axis optical imaging system of claim 20, situated and configured to form an image of the reticle on the substrate.

28. (Amended) An off-axis imaging system for forming an image of an object on a surface, the off-axis imaging system comprising:

(a) a catadioptric optical system that forms an intermediate image of the object, the catadioptric imaging system including:

(i) a concave mirror, and

(ii) at least one diverging lens arranged such that a light flux from the object propagates through the diverging lens to the concave mirror and is reflected by the concave mirror to the diverging lens; and

(b) a refractive optical system that forms an image of the intermediate image on the surface, wherein at least one of the catadioptric optical system and the refractive optical system includes an aspheric optical surface.

29. (Amended) The off-axis optical imaging system of claim 28, wherein [an] a maximum image-side numerical aperture includes a numerical aperture of [is at least] 0.6.

30. (Amended) The off-axis optical imaging system of claim 28, wherein an image height on the [substrate] surface is at least 10 mm.

31. (Amended) The off-axis optical imaging system of claim 28, further comprising a reflective surface arranged to direct a light flux from the catadioptric optical system to the refractive optical system.

32. (Amended) The off-axis optical imaging system of claim 28, wherein the refractive optical system includes an aperture stop.

33. (Amended) The off-axis optical imaging system of claim 28, wherein the aspheric optical surface is a refractive optical surface.

34. (Amended) The off-axis optical imaging system of claim 28, wherein the aspheric optical surface is a reflective optical surface.

35. (Amended) An exposure apparatus comprising:

[a reticle;]

[an ultraviolet excimer] a laser configured to direct an ultraviolet flux to [the] a reticle; a substrate; and

the off-axis imaging system recited in claim 28, situated and configured to form an image of the reticle on the substrate.